A. H. D. No. 88 Rev

Rev. September, 1946

United States Department of Agriculture
Agricultural Research Administration
Bureau of Animal Industry

HORSE MEAT FOR FUR FARMS: ITS CHEMICAL COMPOSITION 1/

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INTRODUCTION

Since horse meat forms so large a proportion of the diets of fur animals, knowledge of its chemical composition is important if rations are to be properly balanced. Some data are available in the literature on the subject. Amberger (1919: 544-545) analyzed samples of the neck, shoulders, ribs, head, chuck, sides, heart, liver, and kidneys of eight horses. The moisture content of these cuts averaged 78.7 percent; the fat, 1.6 percent; and the ash, 1.1 percent. The chemical compositions of the various cuts were in substantial agreement, except that the water content of the liver and kidneys averaged about 2 percent higher than that of the other parts of the carcass. Leach (1920) listed the average analysis of fresh muscle from 16 horses as follows: Water, 69.81 percent; protein (N x 6.25), 19.47; fat, 9.61; and ash, 1.01 percent. Ashbrook (1939) gave the analyses of two composite muscle samples taken from eight horses as follows: Water, 75.0 percent; protein, 20.2; fat, 2.9; and ash, 1.1 percent. Viscera plus blood taken from the same horses averaged: Water, 77.5 percent; protein, 19.8; fat, 1.25; and ash, 1.1 percent.

METHODS AND MATERIAL

For the present study of the composition of horse meat, the freshly slaughtered carcasses of 18 horses and 1 mule were systematically sampled

1 1/ Formerly Wildlife Leaflet 177 issued in December 1945 by the Fish and Wildlife Service, Department of the Interior.

at the United States Fur Animal Experiment Station at Saratoga Springs, N. Y. 1/ Each carcass was divided into five main sections--neck, front legs, ribs, or thorax, loin, and hind legs. The meat was removed from the bones and separately weighed, ground, and well mixed, but the sections kept distinct. The muscle only was used in 17 cases while in the other 2 blood was added. Following mixing, a sample made up of one-tenth, by weight, of the meat from each section was collected and these samples thoroughly mixed. As a preservative 25 ml. of alcohol (95 percent) plus 1 percent hydrochloric acid were added to approximately 400 grams of meat. These samples were shipped to Cornell University, where from a definite quantity of each, analyses were made of moisture, protein, fat, and ash according to U. S. Pharmacopoeia methods. In calculating the moisture content, account was taken of the added acid-alcohol. There was a small remainder after determining the percentages of water, protein, fat, and ash. In the case of plant material this would be listed as nitrogen-free extract. In the case of meat it is listed merely as a remainder, it being unlikely that it consisted entirely of the animal carbohydrate glycogen. Since it is obtained by difference, the remainder contains the accumulated errors of the other determinations.

RESULTS OF STUDY

Table 1 shows the composition of 16 samples of horse muscle; table 2, the composition of 2 samples of horse muscle plus blood and of 1 sample of mule muscle. The 16 muscle samples averaged as follows: Water, 76.0 percent; crude protein, 18.1; fat, 4.1; and ash, 0.9 percent. The two muscle-plus-blood samples did not differ significantly from the straight muscle samples. The mule muscle sample had a higher water content than any of the horse samples but a single analysis does not permit the conclusion that this is a regular characteristic of mule meat.

Tables 1 and 2 show that the most variable constituent of horse meat is fat, which ranged from 0.4 to 12.7 percent; Leach (1920) listed an even wider variation (1.2 to 33.7 percent).

Table 3 gives the approximate ages and condition, or degree of fatness, of the different horses and data on the muscle, viscera, blood, and bone content. Data on the degree of fatness were obtained after slaughter and included observation on both external and internal fat.

1/ The authors acknowledge the technical assistance of Gennard Matrone, Miss Martha Walker, and Harry D. Greenwood, cooperative agents of the Bureau of Animal Industry stationed at the Laboratory of Animal Nutrition, Cornell University.

TABLE 1. -- Chemical composition of fresh horse muscle

Horse	Total moisture	Crude protein (Nx 6.25)	Fat	Ash	Remainder
	Percent	Percent	Percent	Percent	Percent
Kenyon	69.22	16.89	10.63	0.97	2.29
Dake	69.03	18.81	9.83	0.98	1.35
Sabasta	71.48	19.13	7.10	0.97	0.91
James	73.22	18.68	6.52	1.03	0.55
Pasek	72.99	18.08	6.84	0.93	1.16
Skalko	72.97	16.91	7.55	0.86	1.71
Darrow	76.10	17.91	4.35	0.93	0.71
Conde	75.22	19.49	3.93	0.88	0.48
Stevens	79.87	18.35	0.64	0.95	0.19
M. Wolfe	83.66	15.48	0.40	0.66	-0.20
Brennan	81.84	15.68	0.58	1.02	0.88
Barrass	79.37	18.28	1.45	0.90	0.00
Tubb	78.60	18.74	1.42	0.91	0.33
Dunham	77.57	20.11	0.44	1.03	0.85
Hunt	76.43	18.85	1.91	0.99	1.82
Wolf	78.48	18.74	2.00	1.08	-0.30
Average	76.0	18.1	4.1	0.9	0.8
Low	69.0	15.5	0.4	0.7	-0.3
High	83.7	20.1	10.6	1.1	2.3

TABLE 2. -- Chemical composition of fresh horse muscle plus blood, and of mule muscle

Sample	Total moisture	Crude protein (Nx 6.25)	Fat	Ash	Remainder
	Percent	Percent	Percent	Percent	Percent
Yunck (horse)1/	65.55	18.75	12.71	0.94	2.05
Aldrich (horse)2/	76.47	20.06	1.72	1.02	0.73
Beebe (mule)	85.6	12.36	1.65	0.66	0.23

1/ Muscle, 93 percent; blood, 7 percent.
2/ Muscle, 90 percent; blood, 10 percent.

TABLE 3. -- Age, weight of usable portions of meat, and condition of animals examined

Horse or mule	Age 1/	Muscle	Viscera 2/	Blood	Bone	Degree of fatness	Fat 3/	Remarks
	Years	Pounds	Pounds	Pounds	Pounds		Percent	
Shalko	3	491.0	39.7	17.5	134.5	Very good	7.55	Blind, but in very good condition.
Yunck	25	302.0	28.1	22.0	79.0	Good	12.71	Small, but fat.
Kenyon	24	464.0	44.6	39.0	130.0	"	10.63	Lame, but in very good condition.
Dake	25	330.5	31.6	38.0	116.0	"	9.83	Good condition.
Sebasta . . .	29	348.5	43.9	41.5	122.7	"	7.10	" "
James	22	413.5	39.6	40.0	122.8	"	6.52	Very good horse, condition good.
Pasek	35	396.5	35.5	43.5	112.0	"	6.84	Well kept, but very old.
Conde	26	405.3	41.2	40.0	118.0	"	3.93	Well fleshed, good condition, but had heaves.
Hunt	?	493.5	52.5	39.0	115.0	"	1.91	Good in appearance, but had heaves.
Darrow	30	391.5	46.8	40.0	172.0	Fair	4.35	Condition only fair.
Tubb	28	347.0	35.7	40.0	134.5	"	1.42	" " "
Dunham	25	337.6	38.8	38.0	124.5	"	0.44	" " "
Aldrich . . .	26	425.0	43.7	46.0	152.0	"	1.72	Good appearance.
M. Wolfe . . .	32½	342.0	39.8	46.0	129.5	"	0.40	Poor condition, rear quarters thin.
Barrass . . .	30	268.0	46.6	10.0	...	Slight	1.45	Rather large, but poorand thin.
Brennan . . .	7	343.0	39.2	18.5	93.5	"	0.58	Health good, but thin, injured.
Stevens . . .	30	216.0	32.0	25.0	124.0	Poor	0.64	Thin, old, no teeth.
Beebe (mule) .	?	195.0	24.9	26.0	83.0	Slight	1.65	Fair condition.
Wolf	?	294.5	42.3	31.5	130.6	...	2.00	Poor and thin.

1/ Approximate.
2/ Brain, heart, kidneys, liver, lungs, spleen, and tongue.
3/ From Tables 1 and 2.

In the summary of the age, fat content, and the water content of the horse meat samples given in Table 4, it does not appear that age is related either to the fat or the water content. The water content, however, is inversely related to the fat content. When the muscle samples were grouped by high, medium, and low fat content (averaging 8.08, 2.73, and 0.70 percent, respectively), the corresponding water content averaged 71.49, 77.12, and 80.31 percent. That the water content increases as the fat content decreases was also shown by a widening of the protein-water ratios.

TABLE 4. -- Summary of age, fat content, and water content of horse muscle samples

Horse	Age	Fat		Water		Protein-water ratios 1/	
		Each	Average	Each	Average	Each	Average
	Years	Percent	Percent	Percent	Percent		
Kenyon	24	10.63		69.22		1:4.1	
Dake	25	9.83		69.03		1:3.7	
Skalko	3	7.55	8.08	72.97	71.49	1:4.3	1:4.0
Sebasta	29	7.10		71.48		1:3.7	
Pasek	35	6.84		72.99		1:4.0	
James	22	6.52		73.22		1:3.9	
Darrow	30	4.35		76.10		1:4.3	
Conde	26	3.93		75.22		1:3.8	
Wolf	?	2.00	2.73	78.48	77.12	1:4.2	1:4.2
Hunt	?	1.91		76.43		1:4.1	
Barrass	30	1.45		79.37		1:4.4	
Tubb	28	1.42		78.60		1:4.2	
Stevens	30	0.64		79.87		1:4.3	
Brennan	7	0.58	0.70	81.84	80.31	1:5.2	1:4.4
Dunham	25	0.44		77.57		1:3.8	
M. Wolfe	32½	0.40		83.66		1:4.2	

1/ Furnished by R. H. Kerr, in charge of Meat Inspection Laboratories, Bureau of Animal Industry.

Table 5 lists the analyses of horse meat found by Leach (1920), Ashbrook (1939), and the present writers.

TABLE 5. -- Chemical composition of horse muscle as found by various authors

Author	Samples	Moisture	Crude protein	Fat	Ash
		Percent	Percent	Percent	Percent
Leach	16	69.8	19.5	9.6	1.0
Ashbrook	8	75.0	20.2	2.9	1.1
Smith and Bassett	16	76.0	18.1	4.1	0.9
Average	..	73.6	19.3	5.5	1.0

DISCUSSION

There was a definite relationship between the condition of the horses as observed at the time of slaughter and the percentage of fat as shown by chemical analysis. Where the percentage of fat was above average, almost without exception the animal is described as in good or very good condition.

Since the fat content of different parts of a carcass varied so greatly, it is difficult to compare the composition of horse meat, as here determined, with the composition of other meats. Howe and Hankins (1934) listed the average composition of the ninth to eleventh rib cut and of the edible portion of the right side of beef in average condition as follows: Water, 56.1 percent; protein, 16.1; fat, 26.6; and ash, 0.7 percent. The percentage of protein in horse meat is somewhat higher than in beef, while horse meat is much lower in fat. This generalization holds true when the composition of various beef cuts is compared with horse meat. The difference between the composition of beef and horse meat probably can be explained when it is realized that the horses examined were old and mostly in thin condition.

The various minerals present in the ash fraction of horse meat were not determined. Presumably horse meat is similar to beef muscle, in being a good source of potassium, phosphorus, and sulphur, and a poor source of calcium and magnesium.

SUMMARY

Representative samples of muscle from 16 freshly slaughtered horses averaged as follows: Water, 76.0 percent; protein, 18.1; fat, 4.1; and ash, 0.9 percent. One sample of mule meat analyzed as follows: Water, 85.2 percent; protein, 12.4; fat, 1.7; and ash, 0.6 percent.

Fat was the most variable constituent of horse meat, ranging from 0.4 to 12.7 percent. The water content of horse muscle apparently increased as the fat content decreased.

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